

Appendix E

412 Chapter 12 Alcohols, Phenols, Ethers, and Halides

Table 12.3 Molecular Weights, Boiling Points, and Solubilities of Some Simple Alkanes, Alcohols, and Ethers

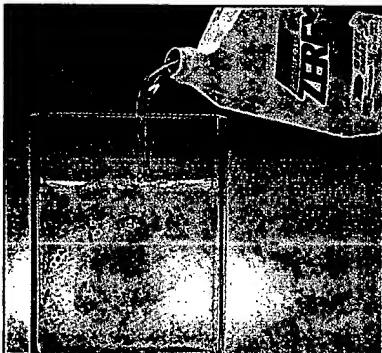
Name	Structural Formula	MW	BP (°C)	Solubility in Water
Ethane	CH ₃ —CH ₃	30	-88	Insoluble
Methanol	CH ₃ —OH	32	65	Soluble
Propane	CH ₃ —CH ₂ —CH ₃	44	-42	Insoluble
Dimethyl ether	CH ₃ —O—CH ₃	46	-23	Soluble
Ethanol	CH ₃ —CH ₂ —OH	46	78	Soluble
Butane	CH ₃ —CH ₂ —CH ₂ —CH ₃	58	0	Insoluble
Ethyl methyl ether	CH ₃ —CH ₂ —O—CH ₃	60	11	Soluble
1-Propanol	CH ₃ —CH ₂ —CH ₂ —OH	60	97	Soluble
Ethylene glycol	HO—CH ₂ —CH ₂ —OH	62	198	Soluble
Pentane	CH ₃ —CH ₂ —CH ₂ —CH ₂ —CH ₃	72	36	Insoluble
Diethyl ether	CH ₃ —CH ₂ —O—CH ₂ —CH ₃	74	35	Slightly soluble
Methyl propyl ether	CH ₃ —CH ₂ —CH ₂ —O—CH ₃	74	39	Slightly soluble
1-Butanol	CH ₃ —CH ₂ —CH ₂ —CH ₂ —OH	74	117	Slightly soluble
1,3-Propanediol	HO—CH ₂ —CH ₂ —CH ₂ —OH	76	214	Soluble

reason is hydroxyl atom, so both

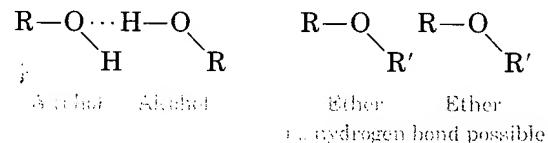
Alcohols and ethers are soluble in water because they form hydrogen bonds. For example, each molecule of ethanol forms hydrogen bonds with the alkyl portion of the next molecule. Because this pattern continues along a chain of molecules, 1-heptanol has a higher boiling point than heptane.

As you might expect, alcohols are more soluble in water than ethers because they have more hydrogen bonding sites.

Review Section 6.6 for a discussion of which molecules can form hydrogen bonds.



Hydrogen bonding accounts for ethylene glycol's viscosity and its solubility in water. (Photograph by Charles D. Winters.)



Alcohols have higher boiling points because hydrogen bonds must be broken during boiling, and this requires energy, available only at higher temperatures. Diols, with two —OH groups, have hydrogen bonds on two sides, so their boiling points are higher still. Hydrogen bonding also accounts for the viscosity of such liquids as ethylene glycol and glycerol.

Solubility in Water

A look at Table 12.3 shows that both alcohols and ethers are soluble in water, up to about three or four carbons. This behavior is, of course, completely different from that of the hydrocarbons and halides. Again, the

12.8 Thiols, Sulfides, and Sulfur Compounds

Thiols and thioethers are similar to phenols, and ethers are similar to alcohols.

but are much more reactive than alcohols and ethers. They are worth mentioning.

1. Thiols have the same properties as alcohols, except that they are more reactive. They are bad smelling and have a tendency to decompose.
2. Thiols are more reactive than alcohols. They react with many reagents, including acids, bases, and oxidants.
3. Thiols are more reactive than ethers. They react with many reagents, including acids, bases, and oxidants.

3. Thiols are more reactive than phenols.